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Energy gain scaling in the Plasma Wakefield Accelerator¹

PATRIC MUGGLI, ERDEM OZ, TOM KATSOULEAS, USC, IAN BLUMENFELD, FRANZ-JOSEPH DECKER, PAUL EMMA, MARK HOGAN, RASMUS ISCHEBECK, RICK IVERSON, NEIL KIRBY, ROBERT SIEMANN, DIETER WALZ, SLAC, CHRIS CLAYTON, CHENGKUN HUANG, CHAN JOSHI, DEVON JOHNSON, WEI LU, KEN MARSH, WARREN MORI, MIAOMIAO ZHOU, UCLA — We recently demonstrated the acceleration of electrons by 38GeV in a 90cm long plasma. The experiment was performed in the nonlinear or blowout regime of the PWFA where the beam density is larger than the plasma density. In this paper we show that the plasma density can be optimized for maximum energy gain. The largest energy gain is obtained at a plasma density of $2.7 \times 10^{17}/\text{cc}$ with an average accelerating gradient of 37 GV/m. The energy gain scales linearly with plasma length, an important characteristic for the possible application of the PWFA to double the energy of a future linear collider. Details of the experimental results will be discussed.

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